t-mac technologies

Panasonic/Sanyo A/C Interface – Modbus RTU Installation Instructions

Preface

Safety warnings

To avoid injury, or damage to the Modbus interface, read all installation and configuration instructions in this guide before installing.

⚠ CAUTION
Do not expose to rain or moisture.

⚠ CAUTION
The installation and assembly of electrical equipment may only be performed by a skilled electrician, improper installation by the user may result in electric shock or fire.

Maintenance
This product contains no user serviceable parts.

WEEE Directive
At the end of their useful life the packaging, product, and any battery should be disposed of by a suitable recycling centre.
Do not dispose of with normal household waste.
Do not burn.

Disclaimer

Warranty

All products manufactured by t-mac Technologies Ltd are warranted against defective materials for a period of one year from the date of delivery to the original purchaser.

⚠ Warning
If the Modbus interface is installed in a manner other than that specified in these instructions, the protection provided by the unit may be impaired. t-mac Technologies Ltd assume no liability for damages consequent to the user/installer of this product. We reserve the right to change this manual at any time without notice. The information furnished by us is believed to be accurate and reliable. However, no responsibility is assumed by us for its use, nor for any infringements of patents or other rights of third parties resulting from its use.

Copyright and acknowledgements

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Introduction

Sanyo/Panasonic manufactures a Communication adaptor (A/C Gateway) to allow their air-conditioning units to be controlled by an external Building Management System (BMS).

The Sanyo (SHA-KA128AGB) and Panasonic (CZ-CFUNC2) A/C Gateways have an RS-485 port which allows them to interface with the Panasonic/Sanyo A/C Interface (Modbus interface) using Panasonic/Sanyo's proprietary S-NET protocol. The Modbus interface will analyse the system on power up and expose information over Modbus. The system will update the information continuously and relevant air-conditioning settings will have read/write access while other information will be read only.

Unpacking

The Modbus interface kit contains the following items:

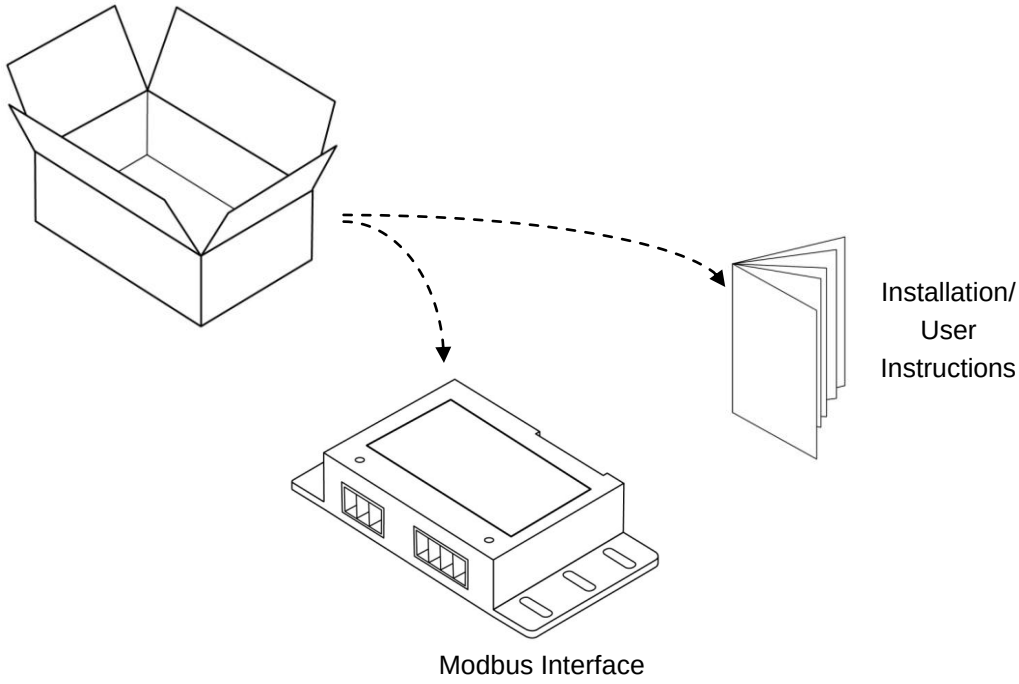


Figure 1: Kit content

Installation

This chapter gives step-by-step instructions for setting up a new Modbus interface installation.

Overview

The Modbus interface has been designed to be installed in residential, commercial, light and heavy industrial environments. The Modbus interface system should be installed in a manner that complies with the Health and Safety Executive (HSE) Memorandum of Guidance on Electricity at Work Regulations 1989.

Modbus interface hardware overview

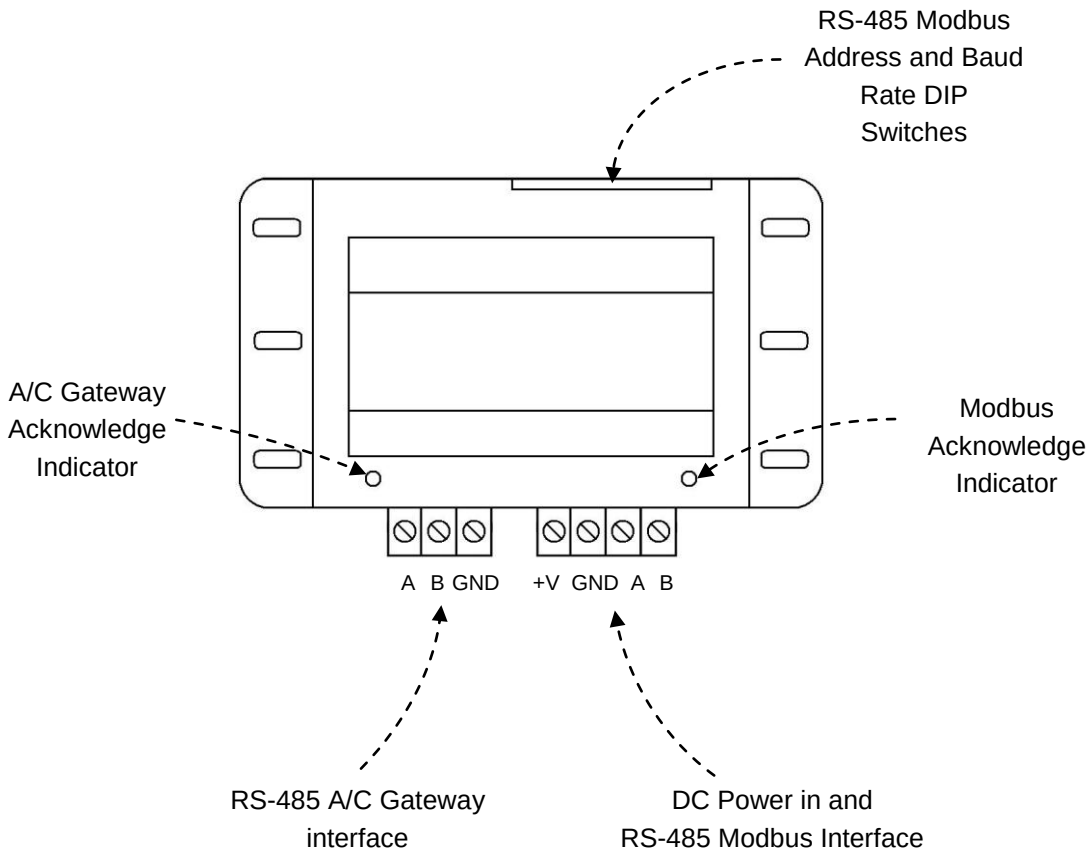

RS-485 Modbus Address and Baud Rate DIP Switches
A/C Gateway Acknowledge Indicator
Modbus Acknowledge Indicator
A B GND
+V GND A B
RS-485 A/C Gateway interface
DC Power in and RS-485 Modbus Interface

Figure 2: Modbus interface hardware overview

Mounting

The Modbus interface should be mounted next to, or near to the A/C Gateway. Suitable space should be provided all around the Modbus interface to allow for cable conduit and additional equipment. The Modbus interface should be located so that it is easy to view the LED indicators.

Enclosure dimensions

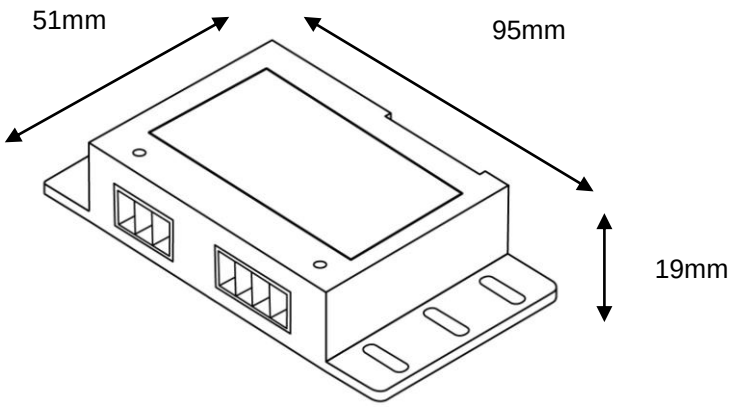


Figure 3: Modbus interface dimensions

Mounting points

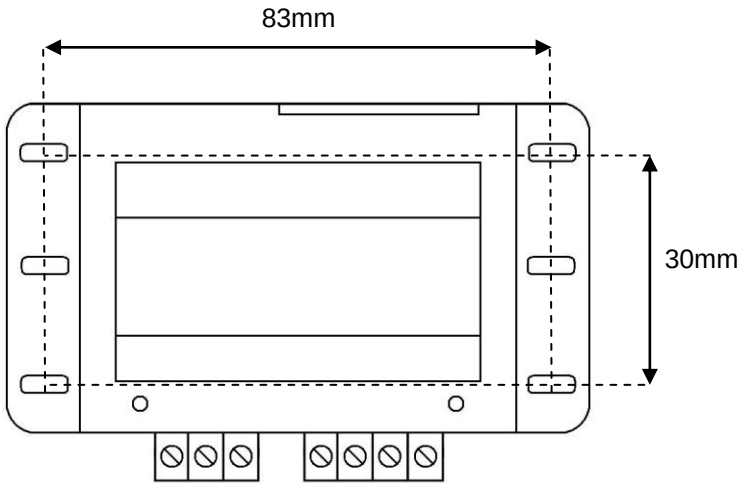


Figure 4: Modbus interface mounting points

Note: Appropriate wall fixings must be used

Connecting power

The Modbus interface requires a 10-30VDC supply.

10-30VDC supply should be connected to the terminal plugs indicated below.

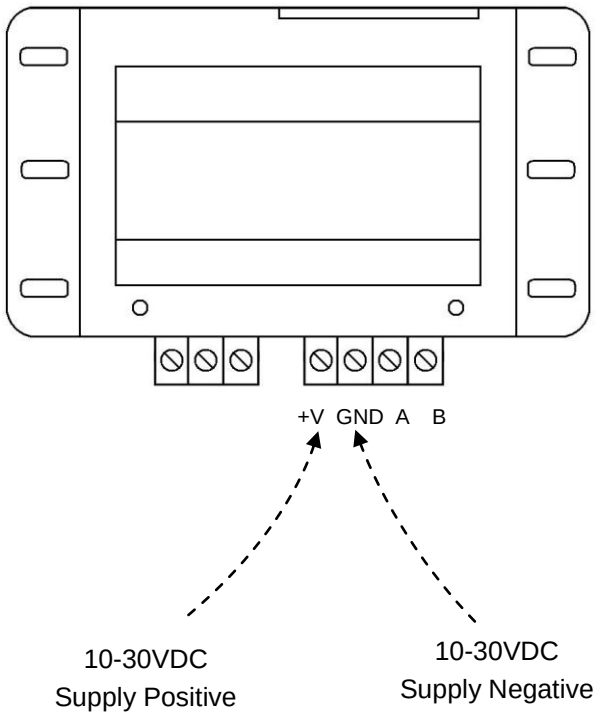


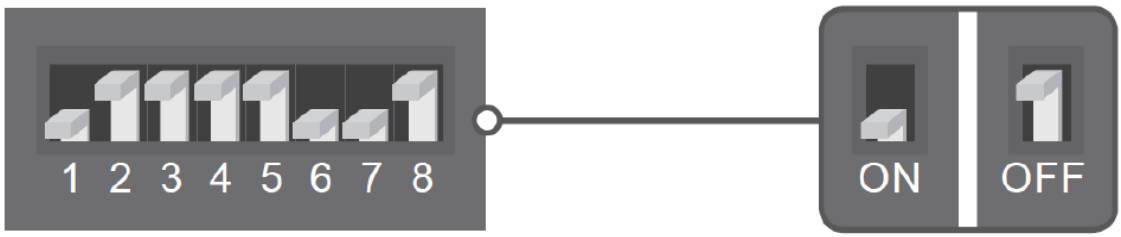
Figure 5: 10-30VDC terminal connection

⚠ DO NOT APPLY POWER YET.

For troubleshooting information regarding powering the Modbus interface, see the *Troubleshooting* chapter.

Settings

There is a bank of 8 DIP switches on the Modbus interface which is used to configure the RS-485 Modbus slave address, and baud rate, and also the A/C Gateway RS-485 baud rate.



RS-485 Modbus slave address

Any Modbus Slave ID in the range 10 – 150 can be chosen using switches 1 – 4. The address is set in binary multiplied by 10, where the switch positions have the following values:

Switch #	switch value when ON
1	10
2	20
3	40
4	80

To get the Slave ID, add together the value for each switch set to ON. For example, to set address 130, set switches 1, 3 and 4 ON (1 + 4 + 8) x 10 = slave ID 130.

Please note: Each Modbus interface connected to the same BMS RS-485 network must be set to a unique address and there must be at least 30 slave IDs between a converter and another device. For example if the first is set to slave ID 10 the next converter (or other MODBUS device) should be set to 40 or greater.

A/C Gateway baud rate

The baud rate of communications used between the Modbus interface and A/C Gateway can be set to 19200 or 9600 baud using the 5th DIP switch.

Switch 5	A/C Gateway Baud Rate
OFF	19200
ON	9600

RS-485 Modbus baud rate

The baud rate of communications used between the Modbus interface and Modbus Master can be set between 1200 and 115200 baud using the 6th, 7th and 8th DIP switch. 9600 baud is set as default.

Switch 6	Switch 7	Switch 8	Modbus Baud Rate
OFF	OFF	OFF	1200
ON	OFF	OFF	2400
OFF	ON	OFF	4800
ON	**ON**	**OFF**	**9600**
OFF	OFF	ON	19200
ON	OFF	ON	38400
OFF	ON	ON	57600
ON	ON	ON	115200

Fixed communications settings

The following Modbus interface to A/C Gateway communication settings are fixed and cannot be changed:

- Adaptor address 0, Link 1
- 8 Data bits
- Even Parity
- 1 Stop Bit.

The following Modbus interface RS-485 Modbus settings are fixed and cannot be changed:

- 8 Data bits
- No Parity
- 1 Stop Bit.

RS-485 termination

Depending upon the application, environment and length of connection between the Modbus interface and the A/C Gateway, and between the Modbus interface and Modbus Master, termination and/or pull up/down resistors might be required. The Modbus interface has built in jumper selectable termination and pull up/down resistors located next to each of the RS-485 connections on the Modbus interface circuit board.

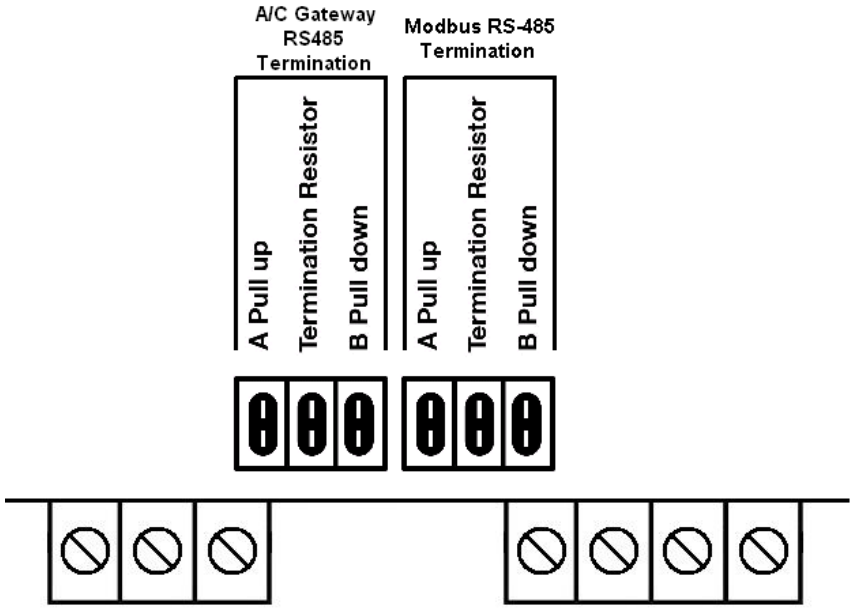


Figure 6: RS-485 termination jumpers

Initial power on

Once the Modbus interface has been configured and the A/C Gateway and Modbus Master are connected, apply power to the unit.

Both the indicators will begin flashing if both communication channels are operating correctly. If either indicator remains off there is a problem with this channel.

For troubleshooting information regarding communications problems, see the *Troubleshooting* chapter.

Summary of Status indicators

There are 2 status LEDs on the Modbus interface. During normal operation the LED indications are as follows:

Indicator	Description
Modbus ACK	**On steadily (Start-up 5s)** – Device is powered **Intermittent flash** – Indicates valid Modbus communications.
A/C Gateway ACK	**On steadily (Start-up 5s)** – Device is powered **Intermittent flash** – Indicates a valid transaction with the A/C Gateway.

Please note: if one or both of the LEDs are permanently on, this indicates that the Modbus interface is powered, but no communication traffic is present. In this case please check the Slave ID and communication settings. Also ensure that both RS-485 networks are wired correctly.

Modbus

Modbus explained

Modbus is a master-slave protocol, which means there are two types of Modbus device, Modbus *Masters* and Modbus *Slaves*.

Slave devices simply wait until they receive a command from a Master, act upon that command and send a reply to the Master. Slaves do not have the ability to send commands to other devices on the bus. Master devices are responsible for sending commands to slave devices and receiving data. Modbus only permits there to be one Master device on the bus at any one time, but up to 247 slaves can be connected at a time.

Each Slave device must have a unique ID on the bus, which is referred to as a *Slave ID*. Each Modbus command the Master sends will contain this slave ID and only the Slave with that ID will reply.

Modbus register table

Modbus Slave devices store data in registers. There are four register types and each type has its own register bank. Any 32-bit values exposed over 2 registers will have the most significant word (MSW) in the first register. The register types are summarised below:

Register Name	Register Type	Description
Discrete Input	Digital Input	Read only register used for holding status information which holds a value of 0 or 1. Can be read using function code 0x02.
Coil	Digital Output	Read and write accessible register which holds a value of 0 or 1. Can be read using function code 0x01. Can be written using function code 0x05 or 0x0F.
Input Register	Analogue Input	Read only register used for status information which holds a 16-bit value (0-65535). Can be read using function code 0x04.
Holding Register	Analogue Output	Read and write accessible register used for status information which holds a 16-bit value (0-65535). Can be read using function code 0x03. Can be written using function code 0x06 or 0x10.

Native Modbus interface registers

The Modbus interface will provide the following MODBUS registers at the Slave ID specified by the DIP Switches.

Holding registers

Holding Registers (Analogue Outputs)			
Register Name	Location (decimal)	Length	Details
Converter State	0	1	Startup = 2, Read = 3, Write = 5, Error = 6 Write 0x55 (85 decimal) to reset the device.

Input registers

Input Registers (Analogue Inputs)			
Register Name	Location (decimal)	Length	Details
Number of indoor units detected	0	1	0-64
Global Fault code	1	1	0-255
Firmware version	2	1	0-65535
A/C Gateway baud rate	3	1	9600 or 19200
DIP switches	4	1	Decimal representation of switches
Indoor Unit 1 Address	20	1	Eg. 101
Indoor Unit 2 Address	21	1	Eg. 102
...	...	...	...
Indoor Unit 63 Address	82	1	Eg. 415
Indoor Unit 64 Address	83	1	Eg. 416

System information

Following on from the Slave ID specified by the DIP Switches, each system appears sequentially with the following registers detailing system information starting at 0. For example System 1 will be the next Modbus Slave ID after that specified by the DIP Switches.

Input registers

Input Registers (Analogue Inputs)			
Register Name	Location (decimal)	Length	Details
Number of units in system	0	1	0-16

Discrete inputs

Discrete Inputs (Discrete Inputs)			
Register Name	Location (decimal)	Length	Details
System fault (one or more units in fault)	0	1	0 = no fault, 1 = fault detected

Indoor unit information

The following information starts at register X00. Where X is the unit number within a system eg for unit 302 its registers will be at 200 on MODBUS slave ID base + 3. These will be available for each indoor unit connected in a system.

Input registers

Input Registers (Analogue Inputs)			
Register Name	Location (decimal)	Length	Details
Return Air Temperature	X00	1	Temperature = (value / 2) - 35 255 (0xFF) = 92.5°C; 0 (0x00) = -35°C
Zone Address	X01	1	3-digit decimal value ZXX Z = zone, XX = unit
Indoor Unit Address	X02	1	Dependent on configuration eg. 101, 102, 201, 301 ...3016
Fault Code	X03	1	0x00 (system OK) - 0xFF

Coils

Coils (Discrete Outputs)			
Register Name	Location (decimal)	Length	Details
ON/OFF status	X00	1	0 = Off, 1 = On
Filter status	X01	1	0 = Clean, 1 = Dirty

Holding registers

Holding Registers (Analogue Outputs)			
Register Name	Location (decimal)	Length	Details
Temperature Setpoint	X00	1	Value to write = (Setpoint + 35) * 2 255 (0xFF) = 92.5°C; 0 (0x00) = -35°C
Mode	X01	1	1 heat 2 cool 3 fan 4 dry 5 auto (indicates auto-heat when read) 6 auto-cool (this cannot be set. AC will decide whether to heat or cool when auto mode is set)
Fan Speed	X02	1	0 auto 1 high 2 med 3 low
Flaps Position	X03	1	1 swing 2 F1 horizontal 3 F2 4 F3 45 degrees 5 F4 6 F5 vertical

Troubleshooting

This chapter gives suggested solutions to problems that users may encounter when installing and configuring a Modbus interface.

If there are problems with either communication channel:

- Ensure the baud rate is set correctly.
- Try adjusting the termination jumper settings for this channel on the Modbus interface.

If the Modbus interface does not seem to be responding to the Modbus Master:

- Ensure the correct slave ID has been set using the DIP switches.

If the Modbus interface does not appear to be powered up, try the following:

- Check the supply to the Modbus interface with a multimeter.

If the Modbus interface does not appear to be communicating with the A/C Gateway, try the following:

- Ensure the correct address is set on the A/C Gateway and this matches the value set on the Modbus interface.

If no units are detected by the Modbus interface:

- Ensure AC system wiring is connected correctly to the appropriate link on the A/C Gateway.

Technical specification

Parameter	Min.	Typ.	Max.	Comments
Power supply				
Voltage	10V DC	24V DC	30V DC	Connection via 1x 4-way 3.81mm
Current		0.1A		pitch connector
Terminals				
Cable size				
3.81mm pitch connectors			16AWG	
			1.5mm²	
Indicators				
2 Status LEDs				Modbus ACK, and A/C Gateway ACK
Communication Ports				
RS-485 (A/C Gateway)		9600b/s	19200b/s	Connection via 3.81mm 3-way connector
RS-485 (Modbus)	1200b/s	9600b/s	115200b/s	Connection via 3.81mm 4-way connector
Environmental				
Operating temperature	-10°C		40°C	
Storage temperature	-20°C		50°C	
Relative humidity			90%	Non-condensing
Environment resist		IP30		
Dimensions				
Length		95mm		
Width		51mm		
Depth		19mm		
Weight		0.2kg		

Appendix A

Manufacturer's 1-year limited warranty

t-mac Technologies Ltd. ("t-mac") warrants all products against defects in materials and workmanship for a period of one (1) year from the date of original consumer purchase in the U.K. If a defect exists during the warranty period, t-mac at its option will either repair (using new or remanufactured parts) or replace (with a new or remanufactured unit) the product at no charge.

THE WARRANTY WILL NOT APPLY TO THE PRODUCT IF IT HAS BEEN DAMAGED BY MISUSE, ALTERATION, ACCIDENT, IMPROPER HANDLING OR OPERATION, OR IF UNAUTHORIZED REPAIRS ARE ATTEMPTED OR MADE. SOME EXAMPLES OF DAMAGES NOT COVERED BY WARRANTY INCLUDE, BUT ARE NOT LIMITED TO, BATTERY LEAKAGE, BENDING, OR VISIBLE CRACKING OF THE PCB, WHICH ARE PRESUMED TO BE DAMAGES RESULTING FROM MISUSE OR ABUSE.

Product returns

Customers wishing to return products or other accessories to t-mac Technologies Ltd. must first call our office (0844 287 0007) and obtain a Return Authorisation (RA) number. RA numbers are valid for 30 days from the date of issuance, and must be obtained within 30 days of purchase date.

Defective products are eligible for credit or replacement within 30 days of Customer invoice date. Replacements will be shipped upon receipt of defective merchandise via ground shipment at our expense, unless customer requests an upgrade at their expense. Advance replacements are available, but must be paid for at the time replacement ships. Shipping address will be provided to customer at issuance of RA. Return shipping on defective merchandise may be reimbursed up to the original shipping cost of the item. Packages must have RA number written visibly on shipping box with a brief description of the product defect inside. All items must be returned in the original packaging. t-mac Technologies Ltd. is not responsible for any item not received at its return address. Allow 14-21 business days for processing returns.

Appendix B

Fault codes

The following list details how fault codes are reported by both the Modbus interface and a Panasonic/ Sanyo wall controller.

Modbus interface	Wall Controller	Description
32	C00	Unused
33	C01	Poor setting on Control Address (duplicated).
34	C02	Discord of number of units in central process control.
35	C03	Miswiring of central process control.
36	C04	Misconnection of central process control.
37	C05	Transmission error of central process control.
38	C06	Reception error of central process control.
44	C12	Lump alarm by local adapter.
48	C16	Poor transmission of the adapter to the unit.
49	C17	Poor reception of the adapter from the unit.
50	C18	Duplicated control addresses in the adapter.
51	C19	Duplication of adapter addresses.
52	C20	Unused
53	C21	Non-volatile memory in the adapter is abnormal.
54	C22	Poor setting of adapter address.
55	C23	Faulty host terminal (software).
56	C24	Faulty host terminal (hardware).
57	C25	Abnormal processing of the host terminal.
58	C26	Communication error in the host terminal.
63	C31	Change of constitution (the adapter detects the change).
64	E00	Unused
65	E01	Poor reception of the signal on the remote controller.
66	E02	Poor transmission of the signal on the remote controller.
67	E03	Poor reception of the indoor unit from the remote controller(central process control).
68	E04	Poor reception of the indoor unit from the outdoor unit.
69	E05	Poor transmission of the indoor unit to the outdoor unit.
70	E06	Poor reception of the outdoor unit from the indoor unit.
71	E07	Poor transmission of the outdoor unit to the indoor unit.
72	E08	Duplicated setting of indoor unit’s address.
73	E09	Setting multiple master remote controllers.
74	E10	Unused
75	E11	Poor reception of the indoor unit from the signal output P.C.B.. (CR-3WAY TG)
76	E12	No auto address setting. (Auto address is in setting)
77	E13	Poor transmission of indoor unit to the remote controller.
78	E14	Duplicated address of master indoor unit in group processing control.
79	E15	Alarm for auto address setting.(Number of indoor units is too small.)

80	E16	Alarm for auto address setting.(Number of indoor units is too large.)
81	E17	Poor transmission from outdoor unit to indoor unit.
82	E18	Poor communication of group processing control caused by miswiring.
83	E19	Unused
87	E23	Poor transmission of CCU to outdoor sub bus.
88	E24	Poor reception of CCU from outdoor sub bus.
89	E25	Poor setting of outdoor sub bus address. (duplicated)
90	E26	Discord of number of outdoor sub bus units.
91	E27	Miswiring of outdoor sub bus.
92	E28	Misconnection of outdoor units.
93	E29	Poor reception of outdoor serial.
94	E30	Poor transmission of outdoor serial.
96	F00	Unused
97	F01	Abnormal sensor for the inlet temp. on the heat exchanger of the indoor unit.
98	F02	Abnormal sensor for mid-point temp. on the heat exchanger of the indoor unit.
99	F03	Abnormal sensor for the outlet temp. on the heat exchanger of the indoor unit.
100	F04	Abnormal sensor for the outlet temperature of the PC compressor.
101	F05	Abnormal sensor for the outlet temperature of the AC compressor.
102	F06	Abnormal sensor for the inlet temp. on the heat exchanger of the outdoor unit.
103	F07	Abnormal sensor for the outlet temp. on the heat exchanger of the outdoor unit.
104	F08	Abnormal sensor for outdoor temperature.
105	F09	Actuation of scroll compressor protective thermostat.
106	F10	Abnormal sensor for suction temperature of indoor unit.
107	F11	Abnormal sensor for discharge temperature of indoor unit.
108	F13	Abnormal sensor for cooling water temperature.
110	F14	Abnormal sensor for engine room temperature.
112	F16	Abnormal sensor for suction and discharge gas.
114	F18	Abnormal sensor for exhaust gas temperature.
115	F19	Abnormal sensor for compressor bottom temperature.
117	F21	Abnormal sensor for compressor 3 current.
118	F22	Abnormal sensor for discharge gas temperature from compressor 3.
119	F23	Abnormal sensor for refrigerant gas 2 temperature in the heat exchanger.
120	F24	Abnormal sensor for liquid refrigerant 2 temperature in the heat exchanger.
121	F25	Abnormal sensor for heat exchanger coil 1 temperature.
122	F26	Abnormal sensor for heat exchanger coil 2 temperature.
123	F27	Abnormal sensor for compressor 1 current.
124	F28	Abnormal sensor for compressor 2 current.
125	F29	Abnormal non-volatile memory (EEPROM) in indoor unit.
126	F30	Abnormal timer (RTC).
127	F31	Abnormal non-volatile memory (EEPROM) in outdoor unit.
128	H00	unused
129	H01	Incorrect current value for compressor 1 .(over current)
130	H02	Incorrect current value for compressor 1 .(locked compressor)
131	H03	CT sensor is dislocated from compressor 1, Short circuited.
132	H04	Protective thermostat for scroll compressor 1.
133	H05	Protective thermostat for scroll compressor 1 is slipped off.

134	H06	Activation of low pressure switch.
135	H07	No oil in compressor 1.
136	H08	Incorrect connection of oil sensor 1.
137	H09	Chattering of magnet switch 1 .(Multi)
138	H10	Defective sensor for crank case heater 1.
139	H11	Incorrect current value for compressor 2 .(over current)
140	H12	Incorrect current value for compressor 2 .(locked compressor)
141	H13	CT sensor is dislocated from compressor 2, short circuit.
142	H14	Protective thermostat for scroll compressor 2.
143	H15	Protective thermostat for scroll compressor 2 is dislocated.
144	H16	No oil in compressor 2.
145	H17	Sensed unbalanced power voltage.
146	H18	Chattering of magnet switch 1 (Espacio).
147	H19	Chattering of magnet switch 2 .
148	H20	Defective sensor for crank case heater 2.
149	H21	Incorrect current value for compressor 3 .(over current)
150	H22	Incorrect current value for compressor 3 .(locked compressor)
151	H23	CT sensor is dislocated from compressor 3, short circuited.
152	H24	Protective thermostat for scroll compressor 3.
153	H25	Protective thermostat for scroll compressor 3 is slipped off.
154	H26	No oil in compressor 3.
155	H27	Incorrect connection of oil sensor 2.
156	H28	Incorrect connection of oil sensor 3.
157	H29	Chattering of magnet switch 3.
158	H30	Defective sensor for crank case heater 3.
192	L00	Unused
193	L01	Incorrect address for indoor unit. (No master indoor unit.)
194	L02	Mismatch of indoor and outdoor units.
195	L03	Setting plural master indoor units for group control.
196	L04	Duplicate setting of system address (outdoor unit).
197	L05	Duplicate setting of priority indoor unit. (for priority indoor unit)
198	L06	Duplicate setting of priority indoor unit. (for other than priority indoor unit.)
199	L07	Group control wiring to individually controlled indoor unit.
200	L08	No Setting of indoor unit address.
201	L09	No Setting of indoor unit capacity.
202	L10	No Setting of outdoor unit capacity.
203	L11	Mis-wiring of group control wire. (Espacio)
204	L12	Discord of indoor unit’s capacity. (Multi)
205	L13	Poor setting of indoor unit’s type.
206	L14	Discord of power frequency. (50,60Hz)
207	L15	Defective double duct bearing.
224	P00	Unused
225	P01	Abnormal indoor fan motor.
226	P02	Actuation of outdoor fan motor, protective thermostats for CM and AC.
227	P03	High discharge temperature of compressor.
228	P04	Actuation of high refrigerant pressure switch.

229	P05	Reversed phase of the power source.
233	P09	Poor connection of ceiling panel connector for indoor unit.
234	P10	Actuation of indoor unit float switch.
239	P15	No refrigerant gas.
241	P17	Abnormal discharge gas temperature from compressor 2.
242	P18	Abnormal discharge gas temperature from compressor 3.
244	P20	Abnormally high refrigerant gas pressure.
245	P21	Abnormal pressure difference in compressor oil.
254	P30	Abnormal sub indoor units in group control. (Centralized processing control detected the abnormality.)
255	P31	Abnormal group control.